1 Lifetime, emittance growth and tune scan at 150 GeV

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Motivations

- Is the emittance growth at 150 GeV on the central orbit due to vacuum alone?
- How does the intensity profile $N(t)$ vs t change with the distance to the aperture? [e.g does it go from $\exp[-\sqrt{t}]$ to $\exp[-t]$ as the aperture becomes smaller?]
- Is the lifetime observed at 150 GeV on the proton helix due to the emittance growth and small aperture?
- Does the lifetime at 150 GeV(and losses after they stabilize) improve when the tunes are moved closer to the diagonal, away from 5th and 7th order resonances?

  The lifetimes and losses will first be observed with coalesced beam, then a more accurate measurement of the tunes will be done with an uncoalesced beam.

  A previous tune scan at 150 GeV (Dec 3rd) looked at instantaneous losses. These may not be the most accurate indicators of good tune values since there is transient behaviour in the losses when tunes are changed.

Measurements

I. Emittance growth on the central orbit

- Beam conditions: 12 coalesced proton bunches at nominal intensities, tunes and chromaticities. Stay at 150 GeV.
- With beam on the central orbit, measure the emittance growth with 3 flying wire scans over a 15 minute period. Observe intensities for a measurable lifetime, if any. Record time stamps.
- Move in horizontal scrapers at F17 until observable beam loss. Stay for 15 mins. and measure emittance growth with 3 FW scans. Record time stamps.
- Move F17 scrapers further in until about 20% beam loss. Measure emittance growth over 15 mins. with 3 FW scans. Using Lumberjack, find the lifetime. Record time stamps.

  If the lifetime in this step is comparable to the lifetime on the proton helix, stop. Dump beam.

  If the lifetime is larger than that on the proton helix, continue.

- Move F17 scrapers further inside in steps until the lifetime is comparable to that on the proton helix. Measure emittance growth, record intensities, positions of F17 scrapers, time stamps.

II. Measure lifetimes vs tunes on the proton helix.

- Beam conditions: 12 coalesced proton bunches at nominal intensities, tunes and chromaticities. Stay at 150 GeV.
- Turn on separators and place beam on the proton helix. Stay for 15 mins., do 3 FW scans to measure emittance growth, record intensities to measure lifetime. Record time stamps.
- Lower horizontal tune ν_x in steps of 3 steps of 0.002 each. At each tune, stay for 15 mins., measure emittance growth with 2 FW scans, record tunes from the Schottky spectra, record intensities(lifetimes), time stamps. Record losses at several places around the ring: CDF, D0, A0 and around C0.

  Move horizontal tune back to nominal value.
- Lower vertical tune ν_y in 2 steps of 0.002 each. Stay for 15 mins. at each tune, measure emittance growth with 2 FW scans, Record intensities, time stamps and losses at several places as in above step.

  Move vertical tune back to nominal value, then raise it by 2 steps of 0.002 each. Repeat above observations.

  Dump beam.

III. Repeat II. with uncoalesced beam on the proton helix.

- Beam conditions: Uncoalesced proton beam on proton helix, same tunes and chromaticities as in II.
- At the same set values of ν_x, ν_y used in II, measure the tunes from the Schottky monitor. Stay at each tune for 15 mins., measure emittance growth with 2 FW scans, record intensities(lifetimes) and time stamps.